

Growth of the head capsule in the successive instars in larvae of *Byasa alcinous* KLUG

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Jakooageha, *Byasa alcinous* KLUG, is one of the biggest and elegantly simple coloured butterflies in Japan. However, due to the restricted distribution of food plants, *Aristolochia*, it is impossible to see as many individuals in the northern parts of Japan, as other species of Papilionidae. In spite of its scanty numbers, the life history of this butterfly has already been elucidated in detail by many earnest butterfly fanciers (SHIRŌZU and HARA, 1960). In the present paper, the writers wish to report concerning the growth of head capsule in the successive instars of this species which was determined from a small number of measurements and has not been discussed yet in any of the previous papers.

MATERIALS AND METHODS

The eggs were collected early in September 1966 in a field of Shimizu, Shizuoka Prefecture. From the day of hatching, they were reared under the constant environmental condition of temperature 25°C and 60% relative humidity, separately in covered Petri dishes having a diameter of 9.0 cm and a height of 1.5 cm, on leaves of the Umanosuzukusa, *Aristolochia debilis* SIEB. et ZUCC. When the moulting was taken place, the width, at the largest part of the exuviae of head capsule of each larva, was measured in each of the successive instars by a projector microscope at the scale of $\times 20$. The food leaves were renewed when they were consumed.

RESULTS AND DISCUSSION

The results of measurement are shown in the left two-thirds of Table 1 in the form of logarithms plus 1. This procedure was taken because both the formulae of DYAR (1890) and of GAINES and CAMPBELL (1935) express the relations between the log-width of head capsule and the instar number, and also because, by removing the negative number in logarithmic values, the computation can be made more easily.

DYAR's rule states that the width of the insect head capsule increases in a constant proportion after each moult, which implies a linear increase in its log-width y with instar number X . GAINES and CAMPBELL stated that the relation between these two variables is much more applicable to the curvilinear equation than to the simple linear equation.

The applicability of the linear equation of DYAR's rule or the quadratic equation of GAINES and CAMPBELL to the measurements of the head capsule of individual larvae in each of five successive instars, can be tested by means of the method of analysis of variance with two orthogonal polynomials (BLISS and BEARD, 1954; BLISS, 1967). That is, to test the significance of the curvature, a parabola, by multiplying the totals T_i by the polynomials x_1 and x_2 for an equally spaced series of 5 instars, can be fitted. As is seen in the results of analysis of variance (Table 2) which was made by compiling all the data on both sexes, individual larvae are not significantly different in their average size (row 1). This means that both females and males had the same growth rate. The result also showed that the average trend B_c^2 is significant (row 2), but the average curvature Q_c^2 is not significant (row 3). It is, therefore, concluded that DYAR's rule could be applied to the present data. The linear equation computed, based on the figures of Table 1, is

$$Y=1.28542+0.16256(X-3).$$

Table 1. Log-width ($y = \log. \text{mm} + 1.000$) of the head capsule in successive instars of individual larva of *Byasa alcinous* KLUG.

Larva No.	Sex	Log-width for instar					T_g	$\Sigma(x_1y)$	$\Sigma(x_2y)$
		I	II	III	IV	V			
1	♀	0.954	1.130	1.267	1.423	1.618	6.392	1.621	0.057
2	♀	0.954	1.114	1.279	1.455	1.613	6.415	1.659	0.007
3	♀	0.954	1.114	1.279	1.455	1.613	6.415	1.659	0.007
4	♀	0.954	1.114	1.301	1.470	1.608	6.447	1.664	-0.062
5	♀	0.978	1.130	1.301	1.462	1.613	6.484	1.602	-0.012
6	♂	0.954	1.114	1.267	1.439	1.597	6.371	1.611	0.015
7	♂	0.954	1.114	1.290	1.462	1.586	6.406	1.612	-0.076
8	♂	0.954	1.130	1.312	1.455	1.602	6.453	1.621	-0.097
9	♂	0.978	1.130	1.301	1.455	1.597	6.461	1.563	-0.037
T_t		8.634	10.090	11.597	13.076	14.447	57.844	14.612	-0.198
x_1		-2	-1	0	+1	+2			
x_2		+2	-1	-2	-1	+2			
\bar{y}_t		0.959	1.121	1.289	1.453	1.605			
Y		0.961	1.123	1.285	1.447	1.610			

Table 2. Analysis of variance of the larval measurements.

Row	Term	DF	SS	MS $\times 10^6$	F
1	Between larva totals	8	0.002114	264.3	2.08
2	Trend on instar, B_c^2	1	2.372339	2372339.0	
2'	Curvature, Q_c^2	1	0.000311	311.0	2.45
3	Scatter about parabola	2	0.000281	140.5	1.11
4	Larva \times linear trend	8	0.000859	107.4	0.85
4'	Larva \times curvature	8	0.001411	176.4	1.72
5	Larva \times scatter	16	0.001640	102.5	
6	Total	44	2.378955		
7	Correction, C_m	1	74.353963		
8	Pooled error	24	0.003051	127.1	

Table 3. Duration of development (day), pupal weight and length of fore-wing in *Byasa alcinous* KLUG.

Sex	No.	Hatched on (1966)	Larval duration						Pupal duration	Pupal weight (mg)	Length of fore-wing (mm)
			I	II	III	IV	V	Total			
Female	1	6/IX	3	4	3	5	7	22	14	1436.6	55
	2	"	3	3	5	4	8	23	14	1265.2	55
	3	"	3	3	4	6	8	24	15	1597.4	58
	4	"	3	3	4	5	8	23	14	1497.8	56
	5	10/IX	3	3	3	5	8	22	14	1541.6	58
	Average		3.0	3.2	3.8	5.0	7.8	22.8	14.2	1467.7	56.4

Continued from Table 3.

Male	6	6/IX	3	3	5	5	6	22	14	1302.1	53
	7	"	3	3	3	4	8	21	12	—	—
	8	10/IX	3	3	3	4	7	20	13	1508.8	55
	9	8/IX	3	3	3	5	7	21	13	1353.9	15
	Average		3.0	3.0	3.5	4.5	7.0	21.0	13.0	1388.3	41.0

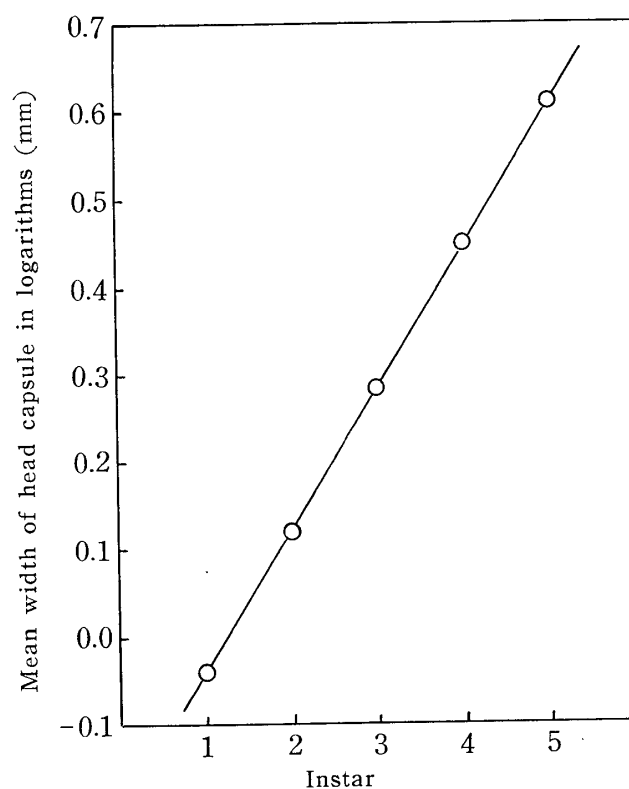


Fig. 1. Relation between mean log-width of head capsule and instar number of *Byasa alcinous* KLUG.

The relation between these two variables is shown in Fig. 1.

The figures of Table 3 are the durations of larval and pupal development, pupal weights and the lengths of adult fore-wings. As mentioned in the preceding paragraph, although no significant difference could be recognized in the growth of head capsule between female and male, it could be generally said that the female takes a much longer time for development than the male. Also females are larger than males in pupal weight and length of fore-wing.

REFERENCES

- (1) BLISS, C. I. and R. L. BEARED (1954) The growth of the head capsule in individual milkweed bugs. *Ann. Entomol. Soc. Am.* **47**: 388-92.
- (2) BLISS, C. I. (1967) *Statistics in biology*. Vol. 1. McGraw Hill Book Co., New York. p. 432.
- (3) DYAR, H. G. (1890) The number of moults of lepidopterous larvae. *Psyche* **5**: 420-2.
- (4) GALNES, J. C. and F. L. CAMPBELL (1935) DYAR's rule as related to the number of instars of the corn ear worm, *Heliothis obsoleta* (FAB.), collected in the field. *Ann. Entomol. Soc. Am.* **28**: 445-61.

- (5) SHIRŌZU, T. and A. HARA (1960) Early stages of Japanese butterflies in colour. Vol. 1. Hoikusha, Osaka. p. 85.

Summary

The relations of log-width of exuviae of head capsule to instar number in *Byasa alcinous* KLUG were presented in DYAR's rule. Any significant difference in growth of head capsule could not be recognized between female and male. However, the females were larger than males in pupal weight and length of fore-wing.

摘 要

ジャコウアゲハ *Byasa alcinous* KLUG 幼虫の頭幅の令期間における成長様式は DYAR の一次式であらわすことができた。この頭幅は、雌雄の間で差がなかった。一方、蛹の重さ、および前翅の長さは、雌が雄より大きかった。

シジミチョウ科の属名 *Ethion* について

林寿一氏の「ボルネオ、主としてサラワクで採集した蝶類の目録」(H. HAYASHI, A list of Bornean butterflies, chiefly taken in Sarawak) の中のシジミチョウ科の no. 7 の種の属名は原稿では *Ethion* となっていたが編集者が著者の了解をえて *Discolampa* と訂正したので、この余白を利用してその理由を説明しておきたい。

属名 *Ethion* は編集者(白水)が三枝豊平氏と共著で発表した論文“*Butterflies collected by the Osaka City University Biological Expedition to Southeast Asia 1957-58 (Part 1)*” (1962, *Nature and life in Southeast Asia*, vol. 2) の p. 63-64 で、従来 *Castalius ethion* WESTWOOD と呼ばれている種 (*Lycaena ethion* WESTWOOD, 1951, in DOUBLEDAY, Gen. diur. Lep. (2): pl. 76, fig. 3 [text (2): 490]) を模式種として創設した属であるが、これは発表後にイギリスの F. HEMMING 氏より白水宛の通信で、同じ種をタイプとした *Discolampa TOXOPEUS*, 1929 (Tijdschr. Ent. 72: 232) の synonym となることが判明した。TOXOPEUS の *Discolampa* は発表後認められず、従って引用されることもなく、われわれはうかつにもこれを見落していたわけである。この synonymy は最近発行された F. HEMMING (1967) の *The generic names of the butterflies and their type-species* (Bull. Brit. Mus. (Nat. Hist.), Entomology Suppl. 9: 147, 171) に明記されているし、*Ethion* が *Discolampa* の synonym となるという事実そのものにも疑問の余地がないので、上記のように訂正した次第である。(白水 隆)

沖永良部島でツマグロキチョウを採集

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1968年3月、沖永良部島で採集を行った際、ツマグロキチョウ *Eurema laeta betheba* JANSON の1♂(秋型)を得たので報告する。白水隆教授によれば同島では水越雄二氏(早稲田生物(15): 88-98, 1966)によって1♂(ガジマル辻, 1965年3月15日)がえられたことがあるのみで、2頭目の記録とのこと。

採集地: 鹿児島県大島郡沖永良部島知名町田皆岬 採集日: 1968年3月22日

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